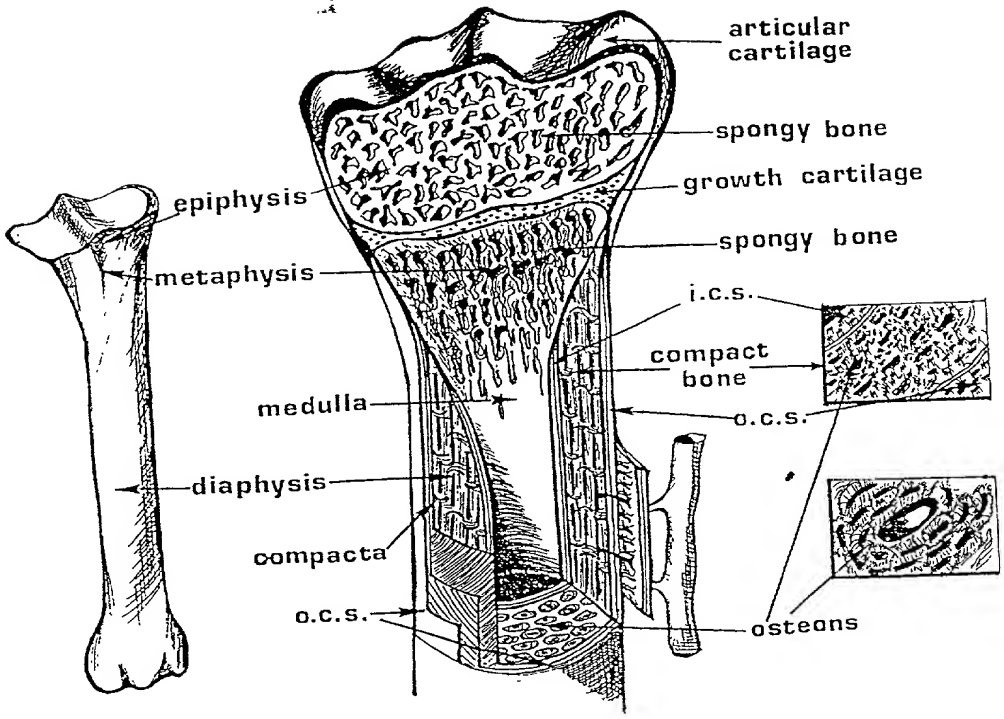
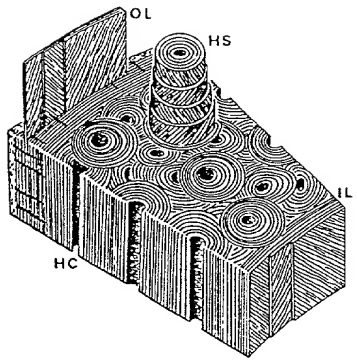


Fig. 1. Schematic representation of tibia upper third; i.c.s. and o.c.s. stand for inner and outer circumferential systems, respectively. Both compact and cancellous bone are represented. (From Bonucci, 2000).



(a)

(b)

Fig. 2. (a) Diagram of a diaphysis sector of cortical long bone. The osteons or harvesian system HS are located between the outer OL and the inner IL circumferential lamellae. The osteonic lamellae are disposed cylindrically around the harvesian canal HC. (From Bouligand, 1986). (b) Cross-sectioned osteons as seen (A) under a light microscope; (B) in a microradiograph; and (C) under the polarizing microscope. (From Bonucci, 2000).

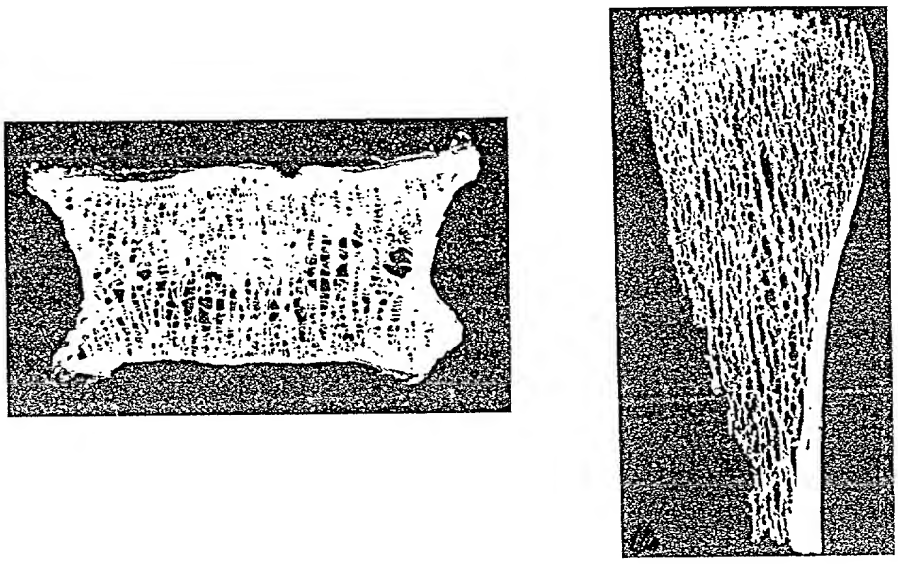


Fig. 3. (a) Section of the body of a lumbar vertebra showing vertical and horizontal trabeculae. The upper and lower surfaces correspond to articular cartilage; (b) Section of half of tibia's upper third. The cancellous bone of the metaphysis consists of comparatively thick vertical trabeculae connected by thin trabeculae. (From Bonucci, 2000).

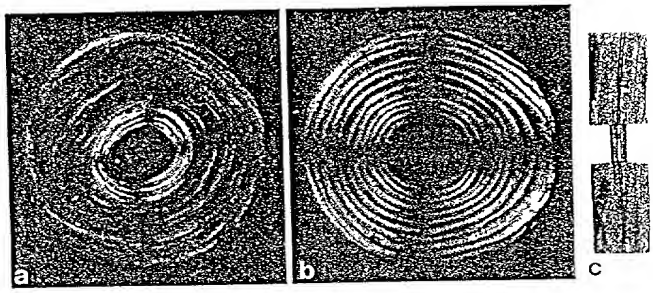


Fig. 4. (a) Cross section of an isolated longitudinal osteon, x 270. (b) Cross section of an isolated alternate osteon, x 270. (c) An isolated osteonic sample with lugs, x20. Lugs are used to grab the sample during mechanical testing. Dimensions: inner diameter 52 µm; outer diameter 225 µm; length 500 µm. (From Ascenzi M.-G., 1999b).

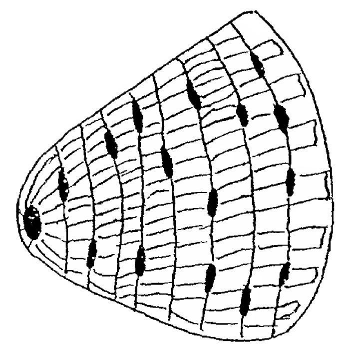


Fig. 5. Diagram of osteon sample in cross-section illustrating the arrangement of canaliculae and lacunae relatively to lamellae. (Based on Fig. 4-11 in *Textbook of Histology* by Leeson *et al.*, 1985).

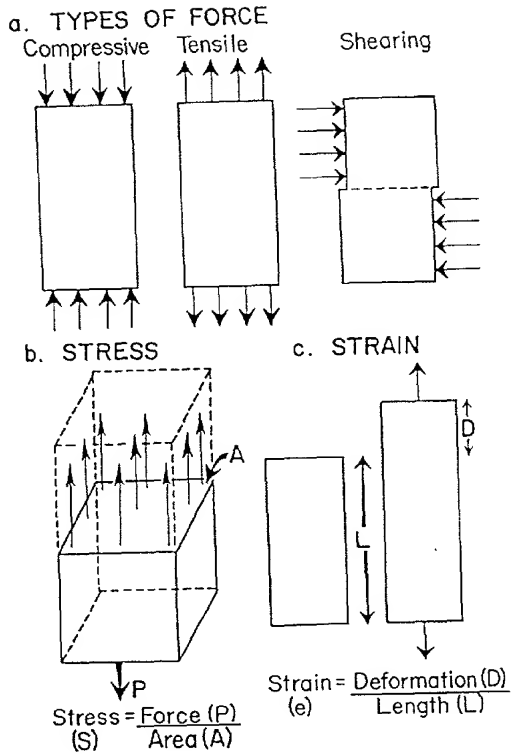


Fig. 6. (a) Types of pure forces. (b) Definition of stress on an area on which the force is constant. (c) Definition of unidirectional strain for D much smaller than L.

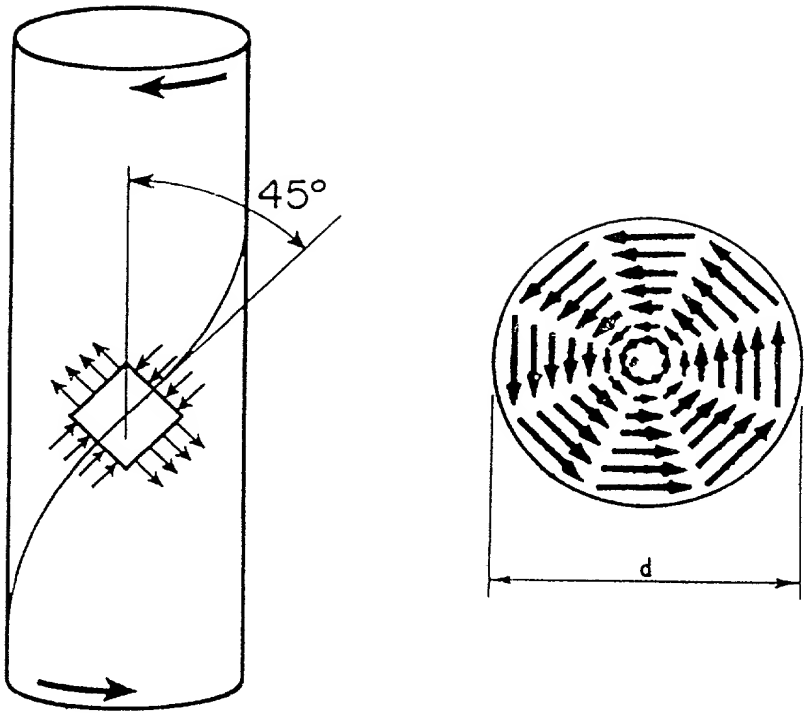


Fig. 7. (a) Tensile and compressive stress distribution during torsion in a material, such as macroscopic bone, which is weaker in tension than in shear (From *Elements of Strength of Materials* by Timoshenko and Young). (b) Shearing stress on the cross section of a specimen subjected to torsion. The arrows' length indicates the magnitude of the shearing stress, which progressively increases from the center to the periphery of the specimen (From *Strength of Materials* by Harris).

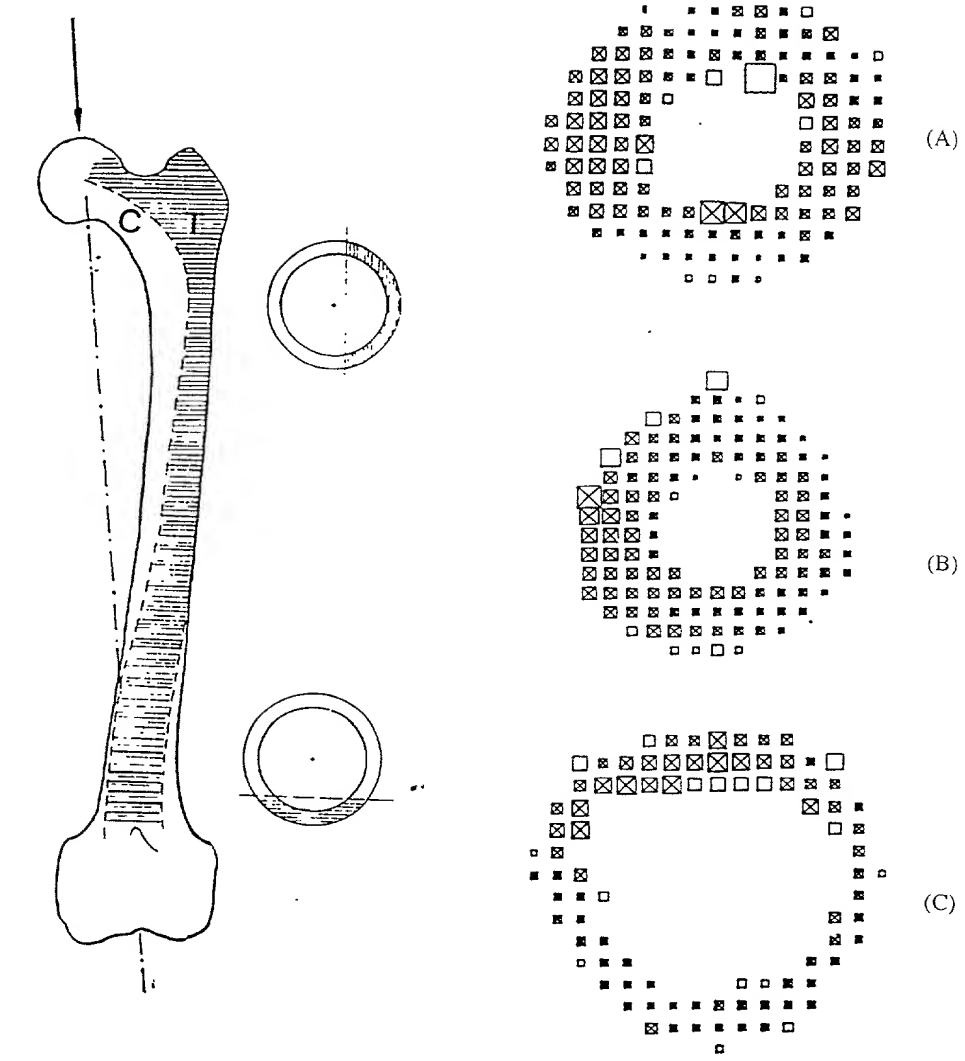


Fig. 8. (a) Bending of femur due to gravity. C (T, respectively) indicates the area under compression (tension, respectively). (b) Diagrams A, B and C display the distribution of transverse and longitudinal lamellae in the sections prepared from the upper, middle and lower shaft. The posterior, anterior, medial, and lateral regions correspond to the top, bottom, left and right regions, respectively, of the page. The distance between the centers of two adjacent square symbols measures 1.86 mm. The size of the square symbol is proportional to the ratio of the bright area in circularly polarized light to bright area in dark field illumination. The regions with dominant transverse lamellae correspond to the regions with concentration of larger squares in the upper medial, middle medial-posterior, and lower posterior shaft, which correspond to the areas in compression in (a). The regions with dominant longitudinal lamellae correspond to the regions with concentration of smaller squares in the upper lateral, middle lateral-anterior, and lower anterior shaft, which correspond to the areas in tension in (a). (From Portigliatti-Barbos *et al.* 1987)

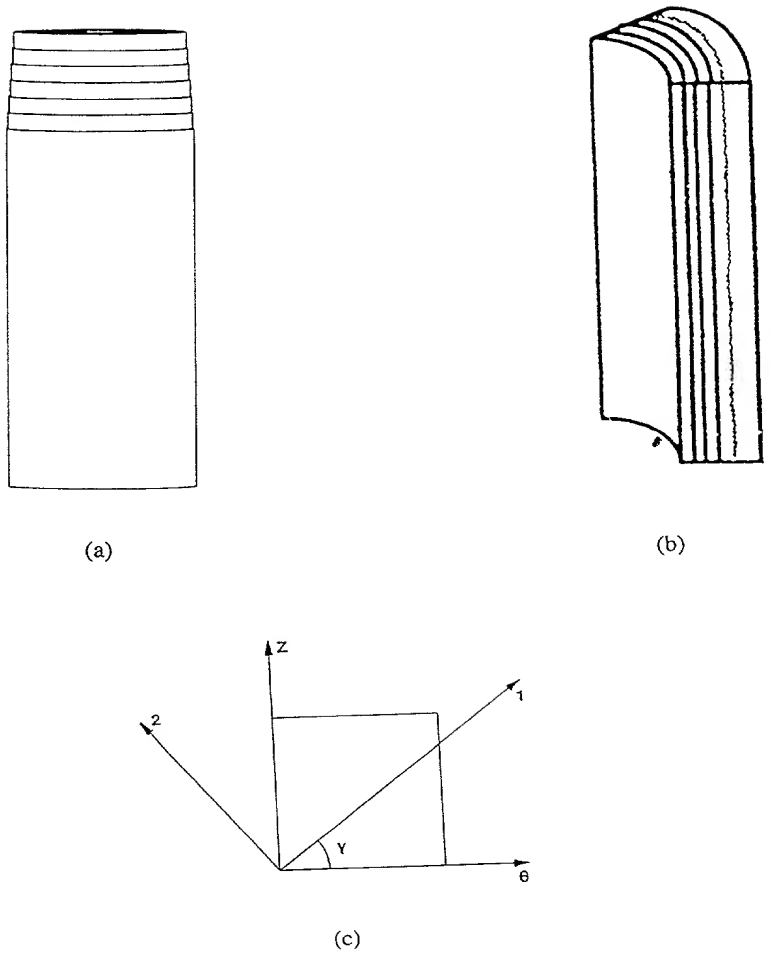


Fig. 9. (a) The osteonic lamellar model is a laminate, which consists of fiber-reinforced unidirectional laminae. The first few external laminae are partially pulled out to show arrangement. (b) The interstitial lamellar model is a portion of the osteonic lamellar model. The picture shows three thin laminae (lamellae) and a thicker lamina (portion of cement line) (From Crolet, 1993). (c) On a small laminar element of constant thickness, the principal material axes are labeled 1, 2 and 3. Direction 1 is parallel and direction 2 is perpendicular to the fibers. Direction 3 is the radial direction perpendicular to the page. Circumferential and axial directions are labeled θ and z. The angle between the circumferential direction and direction 1 is denoted γ. (From Ascenzi M.-G., 1999b)

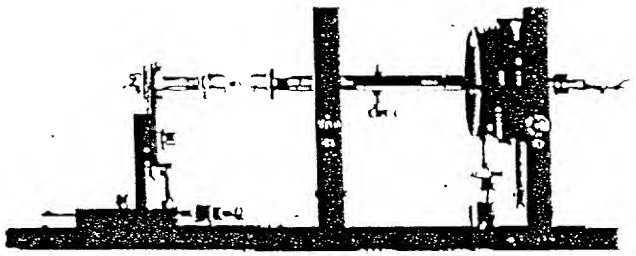


Fig 10 Device for torsional cyclic loading, x ½

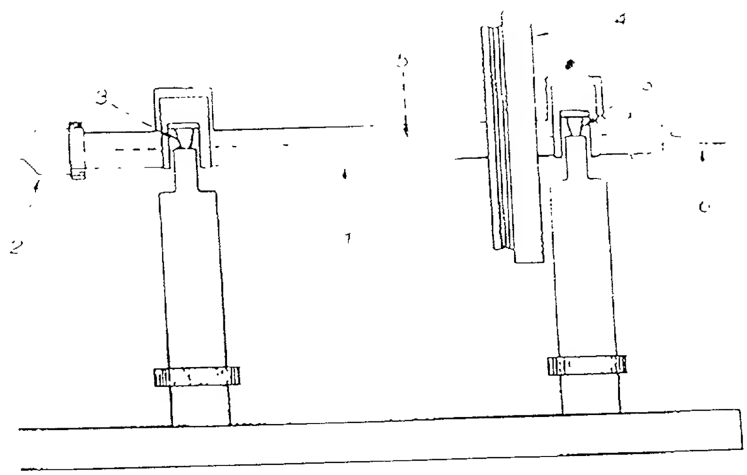


Fig. 11. Schematic drawing of the device used to record torsional cyclic loading. (1) Rotational axis with its jaws (2); (3) hard metal wedges of the pendulum loading system: (4) the wheel around which the tungsten thread loaded with weights is attached; (5) the axis of the pendulum; (6) the mirror.

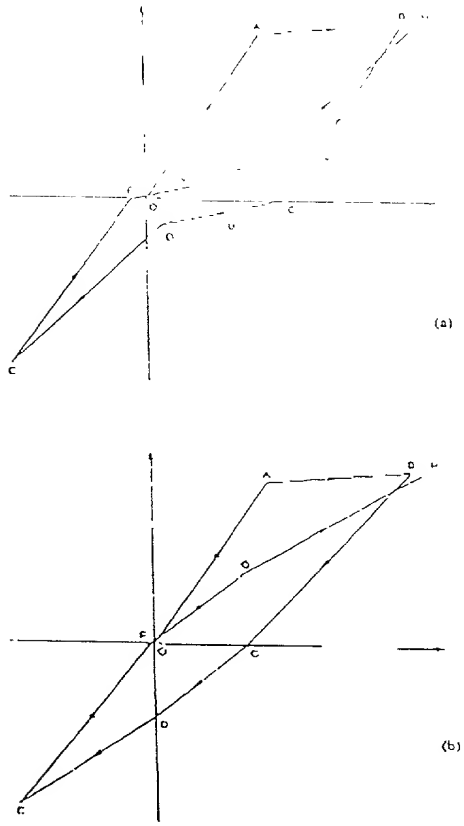


Fig. 12 Idealized bilinear hysteresis model of curve prior to cycling and first cycling loop. (a) Pinching is present. (b) Pinching is not present.

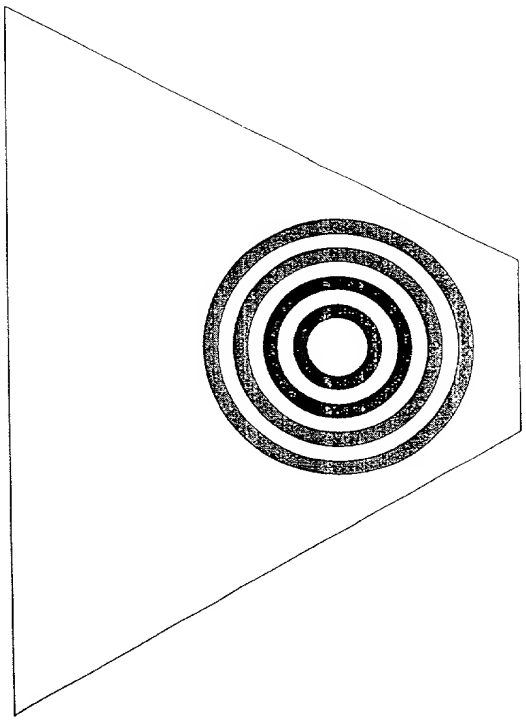


Figure 13

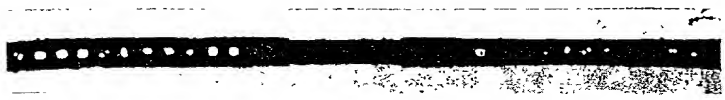


Figure 14

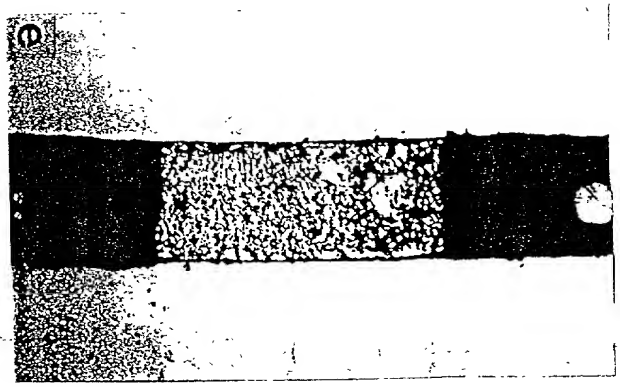


Figure 15

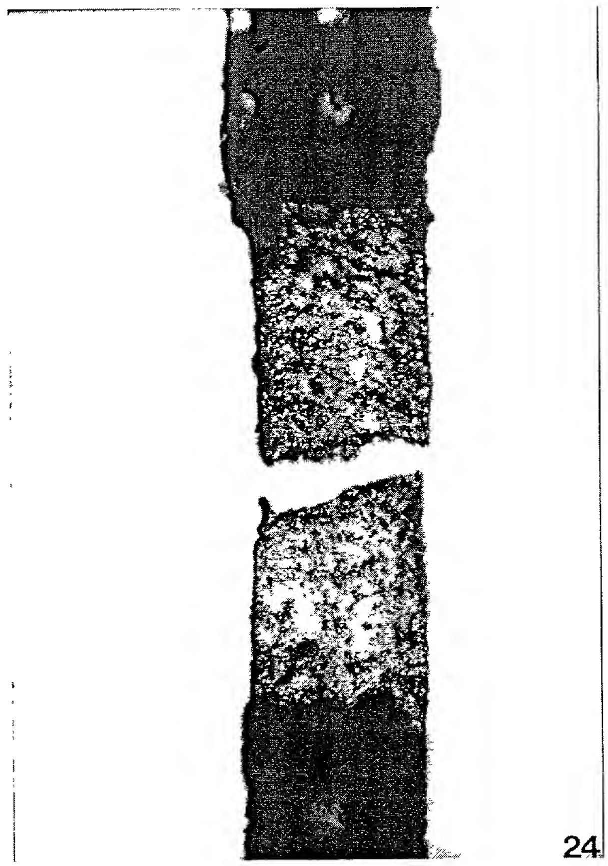


Figure 16

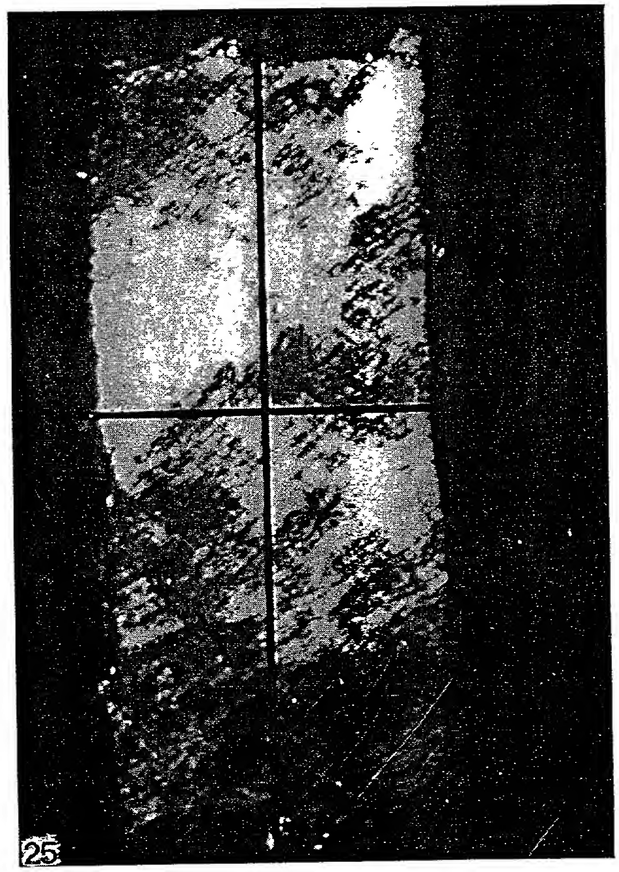


Figure 17

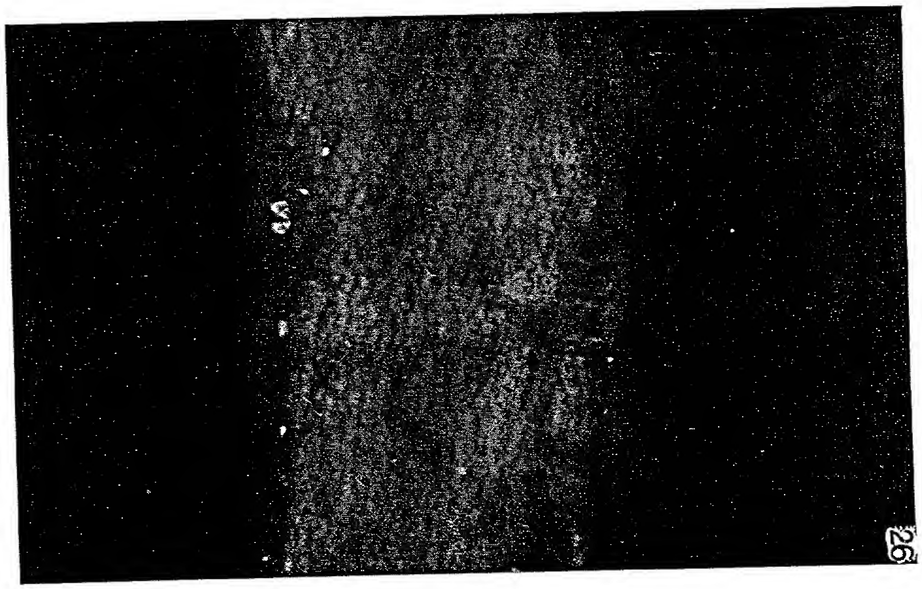


Figure 18

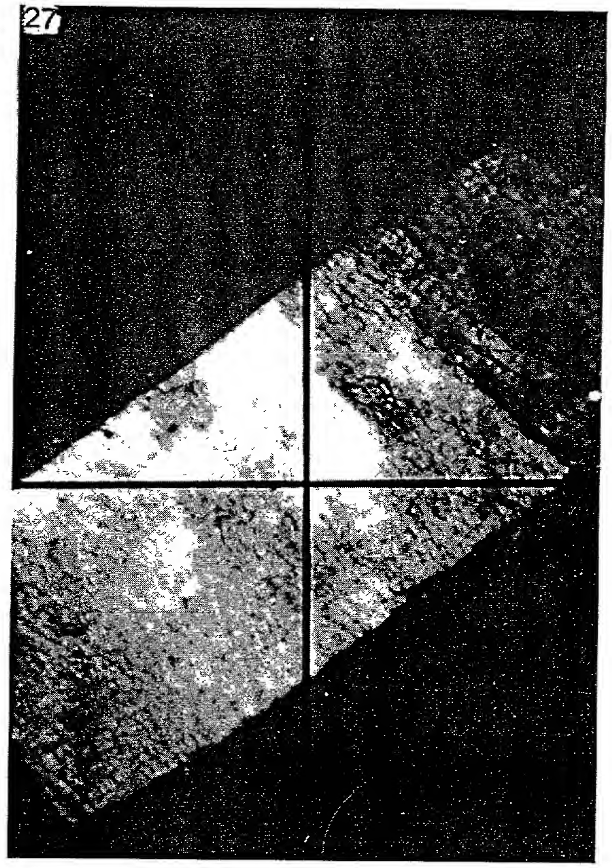
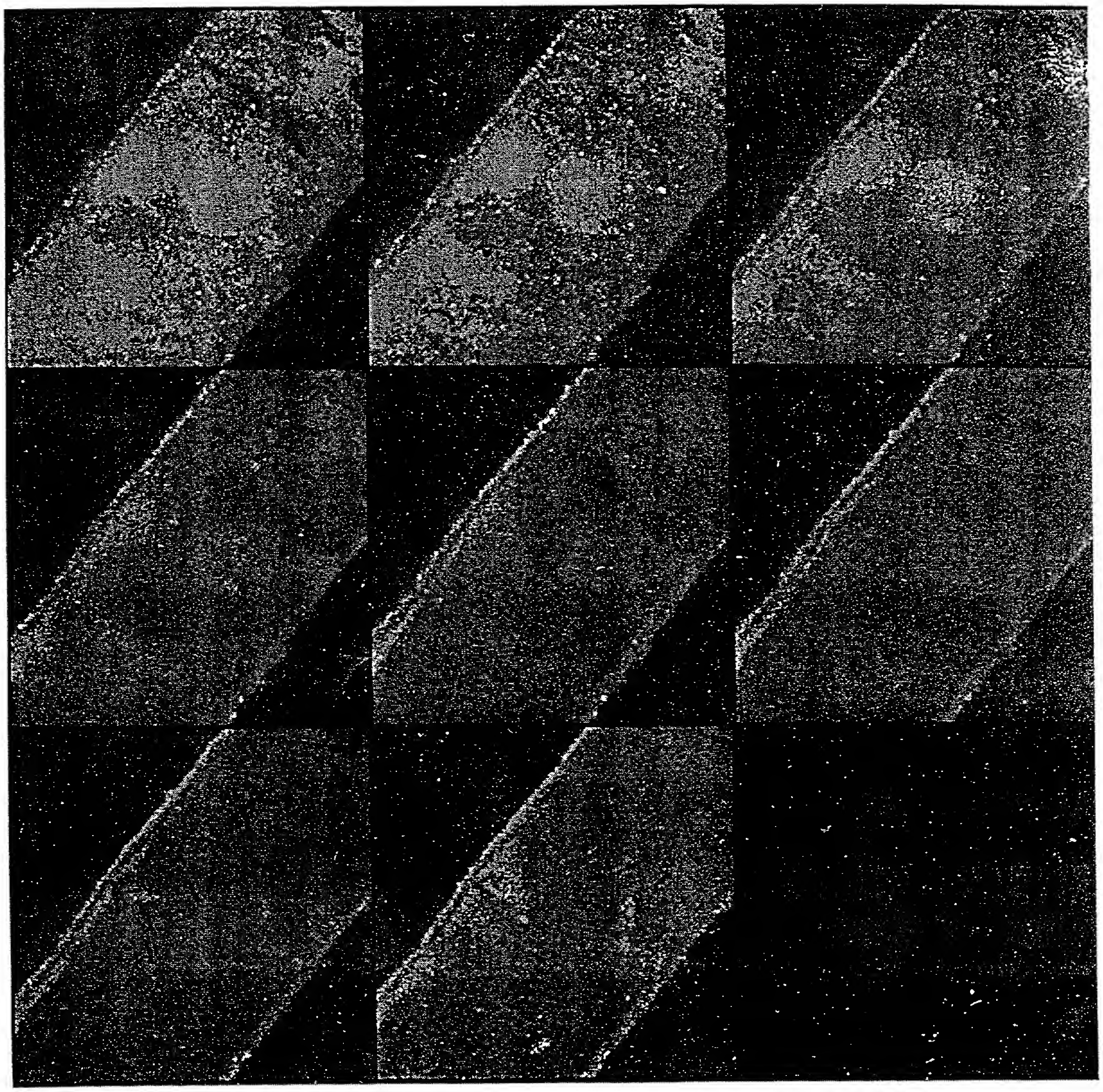
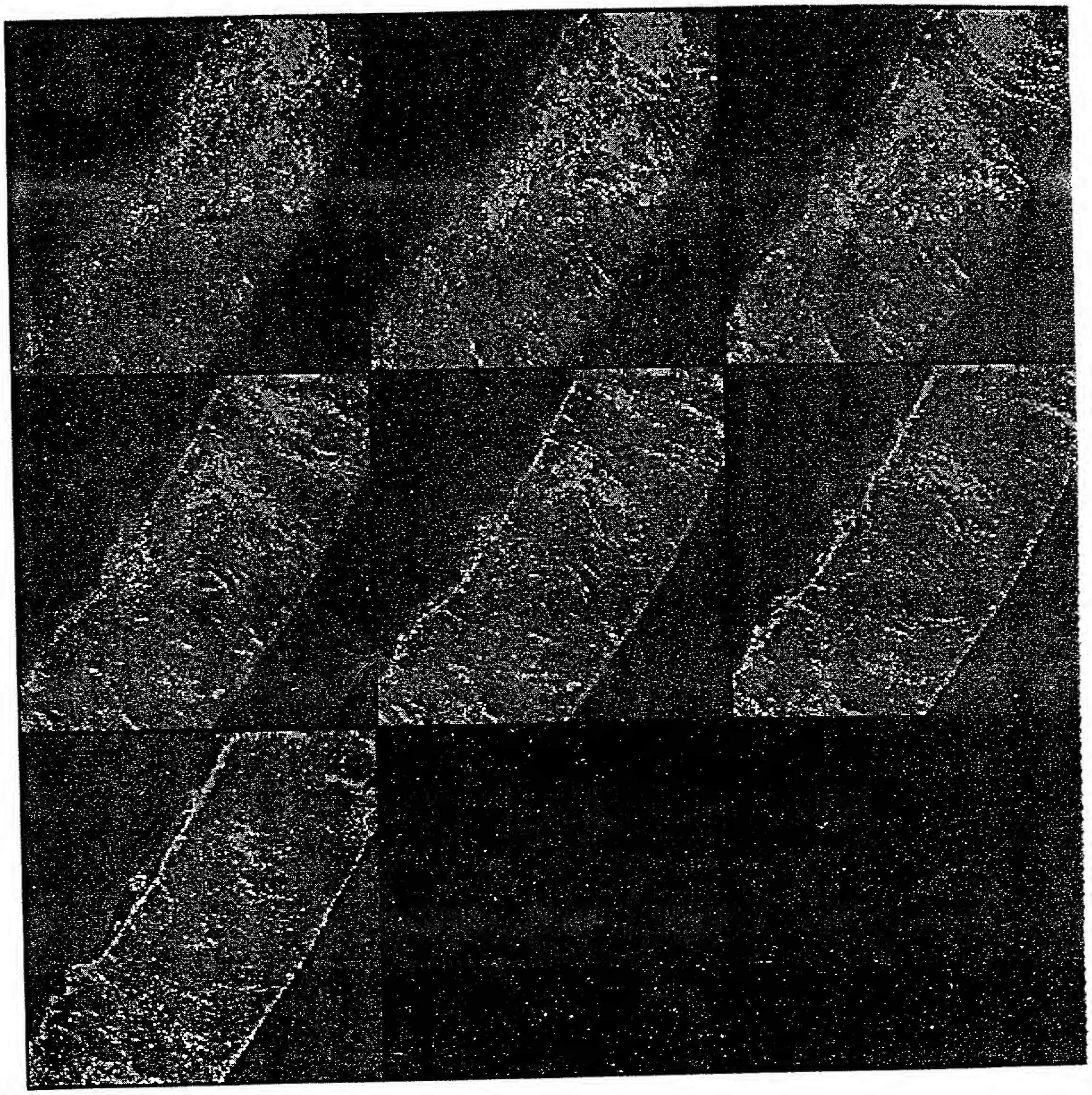


Figure 19



Figures 20(a)-(h)



Figures 21(a)-(g)